NASA/SP—1999–7037/SUPPL402
June 11, 1999

AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

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Includes passenger and cargo air transport operations; and aircraft accidents.

04 Aircraft Communications and Navigation 6

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

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Includes aircraft simulation technology.

06 Aircraft Instrumentation 12

Includes cockpit and cabin display devices; and flight instruments.

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Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

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Includes aircraft handling qualities; piloting; flight controls; and autopilots.

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Typical Report Citation and Abstract

❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
❷ Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
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9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 402)

JUNE 11, 1999

01
AERONAUTICS

19990040214 NASA Langley Research Center, Hampton, VA USA
Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplement 400
May 14, 1999; 63p; In English
Report No.(s): NASA/SP-1999-7037/SUPPL400; NAS 1.21:7037/SUPPL400; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database.

Author

Aeronautical Engineering; Bibliographies

19990040627 NASA Langley Research Center, Hampton, VA USA
An Overview of Recent Developments in Computational Aeroelasticity
Bennett, Robert M., NASA Langley Research Center, USA; Edwards, John W., NASA Langley Research Center, USA; 1998; 15p; In English; 29th; Fluid Dynamics Conference, 15-18 Jun. 1998, Albuquerque, NM, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 98-2421; Copyright; Avail: Issuing Activity; Hardcopy; Microfiche

The motivation for Computational Aeroelasticity (CA) and the elements of one type of the analysis or simulation process are briefly reviewed. The need for streamlining and improving the overall process to reduce elapsed time and improve overall accuracy is discussed. Further effort is needed to establish the credibility of the methodology, obtain experience, and to incorporate the experience base to simplify the method for future use. Experience with the application of a variety of Computational Aeroelasticity programs is summarized for the transonic flutter of two wings, the AGARD 445.6 wing and a typical business jet wing. There is a compelling need for a broad range of additional flutter test cases for further comparisons. Some existing data sets that may offer CA challenges are presented.

Author

Aeroelasticity; Transonic Flutter; Applications Programs (Computers); Computerized Simulation; Airfoil Oscillations

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces, and internal flow in ducts and turbomachinery.

19990038347 Technische Hogeschool, Dept. of Aerospace Engineering, Delft, Netherlands
Effect of Sideslip on the Flow over a 65 deg Delta Wing *Final Report*
Verhaagen, Nicolaas G., Technische Hogeschool, Netherlands; Jan. 1999; 61p; In English
Contract(s)/Grant(s): F61708-97-W0239
Report No.(s): AD-A361146; EOARD-SPC-97-4067; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Flow visualization tests, surface-pressure measurements and balance tests were conducted on a model of a flat plate 65 deg swept delta wing in a low-speed wind tunnel. The model was tested at a fixed angle of attack of 30 deg and at angles of sideslip up to 20 deg. The tests generated data that were used to study the effect of sideslip on the flow over the delta wing.

DTIC

Delta Wings; Sideslip; Flat Plates; Wind Tunnel Tests; Flow Distribution

19990040182 Paisley Univ., Paisley UK

Composite Structures, Special Issue: International Workshop on Experimental Techniques for Composite Structures, Volume 42

Marshall, I. H.; Aug. 1998; ISSN 0263-8223; 88p; In English; Experimental Techniques in the Analysis of Composite Structures, Sep. 1997, Paisley, UK

Contract(s)/Grant(s): F61708-97-W-0029

Report No.(s): AD-A361121; EOARD-CSP97-1005; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

These proceedings are a record of the International Workshop on Experimental Techniques in the Analysis of Composite Structures held at the University of Paisley, Scotland in September 1997. This workshop was jointly sponsored by the University of Paisley and the US Air Force European Office of Aerospace Research & Development (EOARD). The development of future military and civilian aerospace systems depends on new breakthroughs in advanced materials. Composite structures have become indispensable to aerospace designers who continually seek lighter weight, better heat resistance and lower cost alternatives to conventional materials. EOARD is proud to sponsor cutting-edge workshops such as this one that directly contribute to fundamental understanding of this vital material.

DTIC

Composite Structures; Thermal Resistance; Structural Analysis; Composite Materials; Conferences

19990040398 CSA Engineering, Inc., Palo Alto, CA USA

Aeroservoelastic Design with Distributed Smart Actuation System for High Performance Aircraft, *Jul. 1997 - Dec. 1998*

Oz, Hayrani; Dec. 1998; 65p; In English; Prepared in cooperation with Ohio State Univ., Dept. of Aerospace Engineering, Columbus, Ohio.

Contract(s)/Grant(s): F33615-94-C-3200

Report No.(s): AD-A361224; ASIAC-TR-98-04; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes the work done by the author to study the feasibility of shaping lifting surfaces via distributed smart actuation systems to achieve high performance flight configurations. In this report, the focus is on first obtaining and identifying optimal distributed-parameter-control equivalent actuation profiles for desired flight maneuvers by a modal synthesis approach. Subsequently, this distributed-parameter equivalent aeroservoelastic solution is to be implemented via a multitude of spatially-discrete actuators distributed throughout the domain of the lifting surface. The selection of the number and distribution of discrete actuators is to be based on optimal approximation solutions which use the optimal distributed-parameter-control equivalent solution as a guiding design. The insight to solutions are sought by considering the aeroservoelastic interactions among aerodynamics, structural flexibility and control actuators from the perspective of work-energy, control power, and control loading requirements. The aeroelastic modal formulation is presented in terms of real modal matrices and modal-state variables. Real bi-orthonormality relationships for aeroelastic modes are given with respect to structural matrices. The solution for distributed-parameter-control of an aeroelastic system is developed by modal synthesis from modal-state-space control inputs. In particular, the globally power optimal Independent Modal-Space Control (IMSC) technique is used for maneuver (set-point) control of an aeroelastic system by a modal-performance-output synthesis approach. Control power functionals for an aeroelastic system are defined for any actuation profile and control design.

DTIC

Aeroelasticity; Distributed Parameter Systems; Lifting Bodies; Active Control

19990040414 Aerospace Structures Information and Analysis Center, Wright-Patterson AFB, OH USA

Design Studies of Intermediate Complexity Wings

Apr. 1998; 27p; In English

Contract(s)/Grant(s): F33615-94-C-3200

Report No.(s): AD-A361258; ASIAC-TR-98-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Modern-day aircraft employ in the design stage a multidisciplinary process which involves the integration of several disciplines such as aerodynamics, structures, dynamics and controls. Structural optimization is performed to obtain minimum weight for improved performance of the aircraft at minimum cost. Weight reduction can also be achieved by optimizing the structure to meet flutter requirements and still be consistent with such requirements as strength and size constraints. Structural optimization generally involves definition of an objective function and a set of constraints as functions of the design variables. The weight is usually the objective function and the constraints are stresses, displacements, and aeroelastic instabilities such as flutter or divergence speed.

DTIC

Wing [illegible]dynamics; Aeroelasticity; Design Analysis

19990040717 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
ACFD Applications to Predicting Store Trajectories
Cenko, A., Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 1-1 - 1-10; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

ACFD (Applied Computational Fluid Dynamics) is a tri-service project which has the purpose of verifying Computational Fluid Dynamics (CFD) tools for use by the aircraft-store certification organizations. The project is part of the Test Technology Development and Demonstration (TTD&D) program which is funded by the Office of the Secretary of Defense (OSD) Central Test and Evaluation Investment Program (CTEIP). During the past several years several CFD codes have been evaluated for their ability to predict store loads in aircraft flowfields at transonic speeds. The paper presents the latest results of these evaluations for store external carriage loads and trajectory predictions.
Author
Computational Fluid Dynamics; External Store Separation; Trajectory Optimization; Computerized Simulation; Applications Programs (Computers)

19990040718 British Aerospace Aircraft Group, Military Aircraft and Aerostructures, Preston, UK
A Method of Predicting Weapon Ballistics Prior to Flight Trials using Existing 6 DoF Modelling Techniques
Miles, K., British Aerospace Aircraft Group, UK; Alcroyd, G., British Aerospace Aircraft Group, UK; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 6-1 - 6-8; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The process of design and clearance of a modern military aircraft can span decades with the evolution of the design, build, testing and clearance phase leading to the final product. With the drive to shorten these timescales and reduce costs in order to supply the customer with an aircraft as early as possible, any reduction in this cycle time is advantageous. Although the tasks of ballistic modelling and safe separation share a fundamental methodology, in that they both deal with the trajectory of a weapon after it has separated from its parent aircraft, they have until recently been treated as two totally separate tasks. This paper outlines the benefits which can be accrued by using the safe separation models to provide trajectory data ahead of any flight trials. This includes benefits from reductions in both the ground based modelling and flight trials areas, and outlines how this work can improve the accuracy of ballistic data supplied prior to any flight trials work and improve ground impact patterns.
Author
Ballistic Trajectories; External Store Separation; Trajectory Analysis; Mathematical Models; Systems Integration

19990040719 Institute for Aerospace Research, Ottawa, Ontario Canada
Pressure Measurements on a F-18 Wing using PSP Technique
Tang, F. C., Institute for Aerospace Research, Canada; Lee, B. H. K., Institute for Aerospace Research, Canada; Ellis, F., Institute for Aerospace Research, Canada; Yeung, A., Institute for Aerospace Research, Canada; Lafrance, R., Institute for Aerospace Research, Canada; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 7-1 - 7-14; In English; See also 19990040714; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Surface pressure measurements on a 6% scale model of the F-18 have been carried out at the Institute for Aerospace Research 1.5m x 1.5m Trisonic Blowdown Wind Tunnel using the pressure sensitive paint technique. Model configurations included: (1) clean wing; (2) external fuel tanks with empty outboard pylons; and (3) external fuel tanks with two MK-83 and vertical ejection racks on the outboard pylons. In this investigation, pressure data on both the upper and lower wing surfaces as well as over the stores were obtained. The test was performed at a mean chord Reynolds number of 4 x 10(exp 6) and at Mach numbers ranging from 0.6 to 0.95. The angle-of-attack of the model was set at 0 deg and 4 deg nominally with leading and trailing edge flap angles at 0 deg. Detailed quantitative pressure distributions on the model wing surfaces were obtained. Effects of paint surface conditions and temperature variations on the accuracy of the measurements were assessed and are discussed here. The images obtained using the pressure sensitive paint technique also served as a very indicative flow visualization tool.
Author
Pressure Measurement; Pressure Distribution; Body-Wing Configurations; External Tanks; Wing-Fuselage Stores; Aerodynamic Interference; Wing Tanks; Paints; Flow Visualization; Flow Measurement; Wind Tunnel Tests

19990040721 Alenia Aeronautica, Turin, Italy
Alenia Approach to the Aerodynamic Integration of External Stores on Aircraft
Borsi, M., Alenia Aeronautica, Italy; Barbero, S., Alenia Aeronautica, Italy; Gariglio, E., Alenia Aeronautica, Italy; Pellandino, P., Alenia Aeronautica, Italy; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 9-1 - 9-12; In English; See also 19990040714; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The analysis of the store separation trajectories, finalised to the definition of safe release envelopes, is one of the most important tasks to overcome in the aerodynamic design area for the integration of external stores on a combat aircraft. With this paper, Alenia presents the methodologies used in this activity outlining the recent progress obtained with the availability of new advanced tools (Hardware and Software) in the field of CAD and digital image processing.
Author
Aerodynamic Configurations; External Stores; External Store Separation; Systems Integration; Computerized Simulation; Ballistic Trajectories

19990041081 NASA Ames Research Center, Moffett Field, CA USA
Reconstruction of a Three-Dimensional, Transonic Rotor Flowfield from Holographic Interferograms
Yu, Yung H., NASA Ames Research Center, USA; Kittleson, John K., NASA Ames Research Center, USA; AIAA Journal; February 1987; Volume 25, No. 2, pp. 300-305; In English; 23rd; Aerospace Sciences, 14-17 Jan. 1985, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 85-0370; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Holographic interferometry and computer-assisted tomography (CAT) are used to determine the transonic velocity field of a model rotor blade in hover. A pulsed ruby laser recorded 40 interferograms with a 2-ft-diam field of view near the model rotor-blade tip operating of a tip Mach number of 0.90. After digitizing the interferograms and extracting fringe-order functions, the date are transferred to a CAT code. The CAT code, based on the filtered back-projection technique, then calculates the perturbation velocity in several planes above the blade surface. The values from the holography-CAT method compare favorably with previously obtained numerical computations near the blade tip. The results demonstrate the technique's potential for three-dimensional transonic rotor flow studies.
Author
Velocity Distribution; Transonic Speed; Holographic Interferometry; Three Dimensional Models; Rotors; Flow Distribution

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

19990039889 RAND Corp., Santa Monica, CA USA
Analyzing the Effects of Airfield Resources on Airlift Capacity
Stucker, James P.; Williams, Laura M.; Jan. 1999; 92p; In English
Contract(s)/Grant(s): DASW01-95-C-0059
Report No.(s): AD-A361431; RAND/DB-230-OSD; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

Airlift capacity-the number of passengers and the number of tons of cargo that can be delivered to a specific location in a specific period of time-depends on the characteristics of (a) the cargoes to be delivered, (b) the airfields and the routes linking the cargo originations with the cargo destinations, (c) the ground resources at the airfields supporting the air assets, and (d) the air assets-i.e., the aircraft and the aircrews flying those routes. The major mobility studies performed by and for the Office of the Secretary of Defense (OSD) in the 1980s focused on the cargoes, the routes, and the air assets. In the 1990s the focus was expanded to include at least limited consideration of the en route, off-load, and recovery [fields. The air-mobility model of choice has become MASS (Mobility Analysis Support System), a large-scale simulation created and operated by the Air Force's Air Mobility Command (AMC). Ground resources are not modeled but are input as constraints to the airlift model. More recently a series of developments has led to the creation of NRMO (the Naval Postgraduate School/RAND Mobility Optimization), a large-scale linear-programming model of military airlift, and ACE (Airfield Capacity Estimator), a relatively high- resolution model of airfield resources and operations. This study demonstrates the combined use of the ACE and NRMO models to improve and facilitate the analysis of the effects of airfield resources on airlift performance.
DTIC
Airports; Loads (Forces); Cargo; Passengers

19990040172 Dayton Univ. Research Inst., Structural Integrity Div., OH USA
Statistical Loads Data for MD-82/83 Aircraft in Commercial Operations *Final Report*
Skum, Donald; Tipps, Daniel O.; Rustenburg, John; Feb. 1999; 80p; In English
Contract(s)/Grant(s): FAA-96-G-020

Report No.(s): AD-A361459; UDR-TR-98-00077; DOT/FAA/AR-98/65; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The University of Dayton is supporting Federal Aviation Administration (FAA) research on the structural integrity requirements for the US commercial transport aircraft fleet. The primary objective of this research is to support the FAA Airborne Data Monitoring Systems Research Program by developing new and improved methods and criteria for processing and presenting large commercial transport aircraft flight and ground loads usage data. The scope of activities performed involved (1) defining the service related factors which affect the operational life of commercial aircraft; (2) designing an efficient software system to reduce, store, and process large quantities of optical quick access recorder data; and (3) providing processed data in formats that will enable the FAA to reassess existing certification criteria. Equally important, these new data will also enable the FAA, the aircraft manufacturers, and the airlines to better understand and control those factors which influence the structural integrity of commercial transport aircraft. Presented herein are analyses and statistical summaries of data collected from 3987 flights representing 7120 flight hours of six typical MD-82/83 aircraft during operational usage recorded by a single airline. The data include statistical information on accelerations, speeds, altitudes, flight duration and distance, gross weights, speed brake/spoiler cycles, thrust reverser usage, and gust velocities encountered.

DTIC

Commercial Aircraft; Information Retrieval; Transport Aircraft; Statistical Analysis; Research; Data Systems; Loads (Forces); Ground Tests; Dynamic Structural Analysis

19990040399 Army Safety Center, Fort Rucker, AL USA

FLIGHTFAX: Army Aviation Risk Management Information, March 1999, Volume 27, Number 3

Mar. 1999; 12p; In English

Report No.(s): AD-A361225; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This periodical deals with all aspects of Army Aviation. Topics dealt with are Accountability, Leadership, Training, System Safety, Design Deficiency, and Accident Briefs.

DTIC

Management Information Systems; Information Management; Safety Factors

19990040491 Federal Aviation Administration, Office of Aviation Medicine, Washington, DC USA

A Survey of Pilots on the Dissemination of Safety Information *Final Report*

Rakovan, Lori; Wiggins, Mark W.; Jensen, Richard S.; Hunter, David R.; Mar. 1999; 70p; In English; Prepared in collaboration with Ohio State University, Columbus, Ohio and the University of Western Sydney, Sydney, Australia.

Report No.(s): AD-A361233; DOT/FAA/AM-99/7; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A survey was conducted to obtain information from the pilot population on erections of safety-related training currently being offered, its usefulness, and the process through which it might be better disseminated to the general aviation population. The questionnaire assessed use of safety information, safety awareness, computer/video use, pilot self-assessment of proficiency, demographic information, and stressful experiences. In addition, four open-ended questions were included to allow pilots to freely express themselves on a variety of safety issues. The questionnaire was sent to 6,000 pilots (approximately 2,000 each to private, commercial, and airline transport) selected randomly from the pilot population. Responses were received from 1,822 (30.4% of the sample); of the respondents, 31.3% were private pilots, 34.2% were commercial pilots, and 34.5% were airline transport pilots. The frequency of response to all questionnaire items for the three certificate categories are provided, plus analyses of the responses of pilots in a target group consisting of all private pilots and those commercial pilots who had not flown for hire. Analyses also compared the responses of: (1) seminar attendees versus non-attendees, and (2) pilots who had been in accidents versus those who had not. Recommendations to improve the attendance of pilots at FAA-sponsored safety seminars are given.

DTIC

Information Dissemination; Aircraft Safety; General Aviation Aircraft; Air Transportation

19990040865 National Center for Atmospheric Research, Boulder, CO USA

Development of a Method to Test Holdover Times of Deicing and Anti-Icing Fluids in a Cold Room Using Artificially Generated Snow *Final Report*

Rasmussen, R. M.; Knight, C.; Hills, A.; Jan. 1999; 28p; In English

Report No.(s): PB99-129967; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A new method to test deicing fluids under laboratory conditions has been successfully demonstrated. This method generates artificial snow by grinding an ice core fed into a horizontal oriented rotating drill bit. The system is capable of producing snowfall rates from 5 to 50 gm/sq dm/hour over the area of a 30- x 50-cm frosticator plate. Since the snowfall rate can be accurately con-

trolled, other variables such as temperature and fluid type can be varied independently in order to determine the dependence of failure time on each of the variables separately. The current version of the system produces failure times shorter than outdoor and indoor test results of the same fluid type under similar conditions. Preliminary analysis suggests that this may be due to the continuous nature of the snow generation method used in the current system compared to the intermittent snow application techniques used in previous tests.

NTIS

Detectors; Anticing Additives; Low Temperature Environments; Technology Assessment; Laboratories

19990040937 Goodrich (B. F.) Co., Akron, OH USA

Flight Tests of Ice Detection System

Janssens, Leo G., Goodrich (B. F.) Co., USA; The Society of Experimental Test Pilots Technical Publication; 1998; ISSN 0742-1508, pp. 5-26; In English; 14th, 15-16 Apr. 1998, Alexandria, VA, USA; Sponsored by Society of Experimental Test Pilots, USA; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Ever since Jimmy Doolittle pioneered the concept of "blind flying", structural icing has been a major concern during instrument flying. Each year, many aircraft accidents are attributed to icing in low visibility, freezing weather. Most often, the evidence is destroyed along with the aircraft by the ground impact as a result of ice. Consequently, statistics showing ice as the primary cause of a specific accident are hard to assimilate. However an Aircraft Owners and Pilot's Association (AOPA) study of light aircraft accidents for 1994 showed that in 53 total IFR accidents, eight (15%) included ice as a factor. Light single and multi-engine aircraft are the class of aircraft most involved in icing accidents because of their low speed, low altitude envelope where most of the ice producing clouds are formed. The BFGoodrich Company has recently certified a low cost, low electrical power required ice detection system, called the SMARTboot System®, that is suitable for light aircraft. In the future, the system is intended to be adapted to commuter aircraft. The high performance, single engine Piper Malibu was selected for the SMARTboot System flight test task because of its capability to operate in the light plane, low altitude, low speed environment, and in the high altitude environment. The Malibu is pressurized and Federal Aviation Administration (FAA) certified to 25,000 feet. The Malibu is also one of a few single engine aircraft that is FAA approved for flight into known icing conditions. This paper describes the SMARTboot System components development, initial ground testing of the system in the BFGoodrich Icing Wind Tunnel (IWT), and the results of the flight tests in the Piper Malibu based at Akron, Ohio. Correlation of the results of the ground IWT and over 110 hours of actual flight tests, mostly in icing conditions, is also presented. The data from flight tests proved that the SMARTboot System performed its intended function to improve the safety margin during flight in icing conditions.

Author

Ice Formation; Flight Tests; Detection; Flight Conditions; Freezing; Ground Tests; Safety; Ice Clouds

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft, air navigation systems (satellite and ground based), and air traffic control.

19990039166 University Coll. of Wales, Dept. of Physics, Aberystwyth UK

TEC Measurements for GPS Comparisons and Ionospheric Tomography *Final Report*

Kersley, Leonard, University Coll. of Wales, UK; Pryse, S. E., University Coll. of Wales, UK; Lunt, N., University Coll. of Wales, UK; Jones, D. G., University Coll. of Wales, UK; Walker, I. K., University Coll. of Wales, UK; Jan. 1999; 85p; In English

Contract(s)/Grant(s): F61708-97-W0129

Report No.(s): AD-A361128; EOARD-SPC-97-4043; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report results from a contract tasking University of Wales as follows: The contractor will investigate the validity of the SCORE analysis processes for the determination of Global Positioning System (GPS) Total Electron Content (TEC), and also the contribution of the protonospheric section of the path of the propagation error budget.

DTIC

Global Positioning System; Tomography; Earth Ionosphere

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology

19990040173 Military Academy, Operations Research Center, West Point, NY USA
Optimal Mix of Army Aviation Assets
Shupenus, Jon L.; Armstrong, James; Oct. 1998; 68p; In English
Report No.(s): AD-A361461; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Army plan for future heavy division attack helicopter battalion organization calls for a similar organization to that which exists today: three attack companies consisting of three scout helicopters and five attack helicopters each, for a total of nine scouts and 15 attack helicopters per battalion. The scout to attack helicopter ratio has been fairly Consistent over the last thirty years. With the current fielding of AH-64D Longbow Apache and development of RAH-6 Comanche helicopters, it seems worthwhile to evaluate the number and types of helicopters that should be assigned to the attack helicopter battalion. This project investigated the predicted combat effectiveness of a variety of attack helicopter battalion force structures. Both the AH-64D and theRAH-66 were investigated in scout attack roles at three or five helicopters per platoon, with a focus on survivability, lethality and detection capabilities. The analysis contained in this technical report uses experimental design, multiple scenarios, multiple replications and confidence intervals to robustly investigate various battalion designs in an attempt to determine the best attack helicopter battalion force structure to meet the demands of the Force XXI and Army After Next. This project required analysis of each of 16 design points in three high resolutions scenarios. These scenarios were developed in Janus 6.0 and an associated database was edited and refined to create advanced vehicles and aircraft which might be expected for a 2010 combat engagement. A full 2^4 factorial design of experiments, plus a base case, resulted in seventeen design points requiring evaluation. Ten replications of each design point in each scenario, along with a more detailed refinement of two missions, required over 600 combat simulation runs. Analysis of output data revealed that Army development plans for future attack helicopter battalion force structures seem to be on track. 34.
DTIC
Systems Engineering; Effectiveness; Operations Research; Military Helicopters; Attack Aircraft; Experiment Design; Armed Forces; Factorial Design

19990040186 Military Academy, Operations Research Center, West Point, NY USA
1998 Army After Next Unmanned Aerial Vehicle Studies
Sullivan, James F., Jr.; Brouillette, Gregory; Joles, Jeffery K.; Jul. 1998; 62p; In English
Report No.(s): AD-A361106; MA/ORC-TR-98-X; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

There has been growing recognition within the senior leadership of the Army that UAVs are an emerging technology which may play a critical role in the Army After Next. The CSA directed Army After Next (AAN) effort to frame issues vital to the development of the US Army after about 2025 and to provide those issues to senior Army leadership in a format suitable to integration into TRADOC Combat Development programs. The Army After Next Directorate and the Director of TRAC Leavenworth initially requested USMA to analyze a proposed notional UAV force structure and provide recommendations and alternatives. to date, USMA has been involved with the Tactical Wargames, conferences, In Progress Reviews, has conducted some initial modeling which has resulted in a UAV requirements analysis focused on the Battle Element, and has presented a final briefing to the Directors of the AAN, TRAC Leavenworth, and the Battle Lab Integration Technology and Concepts Directorates. Some potential key insights concerning the contribution of future Unmanned Aerial Vehicles (UAVs) systems have been brought to light.
DTIC
Remotely Piloted Vehicles; Pilotless Aircraft

19990040650 American Inst. of Aeronautics and Astronautics, Reston, VA USA
Wings: AIAA/Cessna/Student Design/Build/Fly Competition, Wichita, Kansas *Final Report, 1 Apr. - 31 Dec. 1998*
Page, Gregory; Bovias, Chris; Selig, Michael; Paczula, Robert; Jan. 17, 1998; 778p; In English
Contract(s)/Grant(s): N00014-98-1-0493
Report No.(s): AD-A361001; No Copyright; Avail: CASI; A[illegible] Hardcopy; A10, Microfiche

This report is made up of the combined reports of [illegible]e teams of students who entered the 1998 Design, Build & Fly Competition. The objectives of the Design, Build & Fl[illegible]tation were to have students teams design, build and fly unmanned remote control electric aircraft designed for maximum [illegible] on a limited battery. A "fly off" took place on the Westport Airport near Wichita, KS. in April 1998. Winners of the contest: 1st place, University of Southern California; 2nd, Texas A&M University;

3rd, Syracuse University. The Design, Build & Fly Competition was supported by Cessna the Office of Naval Research and the AIAA Foundation.
DTIC
Aircraft Design; Cessna Aircraft; Pilotless Aircraft; Remote Control

19990040717 Naval Air Systems Command, Advanced Aerodynamics Branch, Patuxent , MD USA
F/A-18C Store Carriage Loads Prediction and Mutual Interference Aerodynamics
Kern, S. B., Naval Air Systems Command, USA; Findlay, D. B., Naval Air Systems Command, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 5-1 - 5-7; In English; See also 19990040714; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

A computational aerodynamics study of the integration of a variant of the Joint Direct Attack Munition (JDAM) store onto the F/A-18C aircraft was performed. Computational forces and moments, derived from hybrid Euler/Navier-Stokes solutions, correlated fairly well with available wind tunnel test data across a wide angle-of-attack range at both transonic and supersonic free-stream flow conditions. The computational results were analyzed to explore the aerodynamic influence of the store on an adjacent fuel tank, and the aircraft wing and fuselage. The addition of the JDAM caused a 16% reduction in the outboard yawing moment of the 330 gallon tank. The presence of the store had nearly no effect on the forward 30% of wing; however, there were significant effects on both the upper and lower surfaces of the wing aft of mid-chord. The influence of the store was so pervasive that it was detectable as far forward as the canopy and as far aft as the empennage.
Author
F-18 Aircraft; Computational Fluid Dynamics; Aerodynamic Interference; External Store Separation; Wing-Fuselage Stores

19990040724 Naval Air Warfare Center, Aircraft Division, Patuxent River, MD USA
The USA Navy's Integrated Approach to Store Separation Analysis
Taverna, Frank, Naval Air Warfare Center, USA; Cenko, Alex, Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 13-1 - 13-8; In English; See also 19990040714, Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The current USA Navy approach to store separation analysis employs a combination of wind tunnel testing, flight testing, and computational aerodynamic analysis. This Integrated Test and Evaluation approach ensures safe separation of stores in a timely and cost effective manner. This approach has evolved over the past decade and is unique because it is performed by an Integrated Product Team (IPT) which belongs to one, physically co-located organization. During the past several years this approach has been responsible for providing considerable time and cost savings to many programs, including the F-18C/JDAM, F-14/GBU-24, F-18C/JSOW, and DC-130/BQM-74 programs. This approach is presently being applied to the F/A-18E/F aircraft/store integration program to both reduce the program cost and ensure the success of the program.
Author
Aerodynamic Characteristics; External Store Separation; Design Analysis; Systems Integration; Systems Compatibility; Computerized Simulation; Flight Tests

19990040725 Naval Air Systems Command, Patuxent , MD USA
F/A-18E/F Trajectory Improvement Study
Chaddock, Dale R., Naval Air Systems Command, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 14-1 - 14-12; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The original F/A-18E/F configuration based on preliminary analysis predicted the existence of a major store separation problem due to a more adverse flowfield than the F/A-18C/D aircraft. Several reasons contribute to the problem which include a wider fuselage, larger wing area and thicker wing, new inlet design with more inlet spillage, and an additional pylon station on each wing. The wing pylon stations were left at there original locations relative to the aircraft centerline. After extensive weapons separation testing and trajectory analysis in the AEDC 16T transonic wind tunnel, it was projected that the current aircraft configuration had a major separation problem and would not meet the E/F release and jettison specification requirements. Therefore, a major trajectory improvement study was undertaken to improve the release and jettison operational envelopes.
Author
Aircraft Configurations; Trajectory Analysis; Ballistic Trajectories; Jettisoning; Wing-Fuselage Stores; External Store Separation; F-18 Aircraft; Flight Tests; Wind Tunnel Tests

19990040727 Naval Air Systems Command, Patuxent , MD USA

Weapon Systems Integration in Existing Aircraft

Reiber, Carl, Naval Air Systems Command, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 16-1 - 16-6; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper addresses the primary factors that allow the acquisition process to purchase an effective retrofit kit that meets evolving U.S. Navy's P-3 Fleet requirements, using my personal experiences in the weapon systems integration and modification of existing P-3C aircraft. These factors are analogous to any aircraft modification encompassing weapons integration. Contributing factors include procurement policies, analog versus digital interfaces, man-machine interface, and testing. The pros and cons associated with the use of non-military standards, COTS, or NDI in a cost-effective way will also be exemplified using the P-3C Update III Block Modification Upgrade Program (BMUP) that the U.S. Navy's Maritime Surveillance Aircraft Program Office is executing.

Author

P-3 Aircraft; Weapon Systems; Systems Integration; Systems Compatibility; Performance Tests; Systems Simulation; Mathematical Models

19990040728 Army Aviation and Missile Command, Aviation Research, Development, and Engineering Center, Redstone Arsenal, AL USA

Rotary Wing Stores Integration (RWSI) Process

Obermark, J., Army Aviation and Missile Command, USA; Johnson, M., Army Aviation and Missile Command, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 18-1 - 18-6; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper gives an overview of the Rotary Wing Stores Integration (RWSI) process which has been developed to improve the current process of weapons integration with helicopters in the area of separation analysis. Several tools have been developed to implement this process. Their function and position within the process will be covered. Some background into the current process is provided. The current process is used to define the goals and requirements of the improved process. These requirements suggest the tools which are developed to implement the new process. The resultant tools are explained, along with their position and function within the new process. The verification and validation process of the tools is shown. The results and improvements which result from the new process are explained. Finally, the resultant process is analyzed to suggest improvements and tools for the future process.

Author

Rotary Wing Aircraft; External Store Separation; Weapon Systems; Systems Integration; Systems Compatibility; Computerized Simulation; Systems Engineering; Applications Programs (Computers); Mathematical Models

19990040729 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Flugmechanik, Brunswick, Germany

Helicopter/Weapon System Integration: An Overview and Synopsis of AGARD LS 209

Gmelin, Bernd L., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 19-1 - 19-10; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The helicopter is fast approaching a half century of service as a weapon system. From humble beginnings after World War II, largely in the roles of observation platforms and search and rescue vehicles, rotorcraft have evolved to a principal in the modern battle scenario. In the war at sea, the helicopter forms an integral part of a task force capable of launching devastating firepower at surface and subsurface targets. In the airland battle, technology has made the helicopter into a tank killer, troop transport and night observation platform. Finally, in the most unlikely arena, air-to-air combat, modern weaponry has shown the helicopter to be effective against even high performance tactical aircraft. Under ideal circumstances a new helicopter design is being directed towards certain weapon capabilities, making the weapon integration discipline a mature part of the design process. However, the rapid pace of weapons development often leads to airframe modification programs and weapons kits make high-technology weapons subsystems a part of older aircraft. In such cases, the system integration efforts is sometimes reduced to "cut-and-try". At best, such an approach may be inefficient at worst it may be unsafe. The AGARD Flight Vehicle integration Panel and the Consultant and Exchange Programme decided to set up in 1997 the Lecture Series 209 on Helicopter/Weapon System Integration. The Lecture Series considered the problems of integrating externally mounted weapons on helicopters with the focus on aeromechanical, structural and operational issues. New aspects in the field of helicopter/weapon system integration were addressed and strong emphasis was placed on the lessons learned from recent experiences in actual development programs. Case histories of weapons integration

on the AH-64 Apache, the RAM-66 Comanche, the EH-101, and the Tiger were presented and discussed. This paper is intended to give an overview of the material provided in the lectures and to draw some essential conclusions from the discussions.
Author
Military Helicopters; Weapon Systems; Weapons Development; Systems Integration; Systems Compatibility; Aircraft Configurations

19990040730 Naval Air Warfare Center, Airframe, Ordnance, and Propulsion Div., China Lake, CA USA
Applications of Modern Multidisciplinary Approaches to the Integration of Weapons on Aircraft
Jeter, Edward L., Naval Air Warfare Center, USA. Aircraft Weapon System Compatibility and Integration; April 1999, pp. 20-1 - 20-14; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Modern computational methods are used extensively in the weapon integration process. These methods include, but are not limited to, computational fluid dynamics (CFD), three-dimensional solids modeling, finite element methods, linear and nonlinear structural mechanics, and multi-body dynamic systems analysis. While CFD methods are commonly used for aerodynamic predictions, the magnitude of numerical calculations associated with them often precludes their integration into multidisciplinary design environments. On the other hand, modern aerodynamic analysis procedures based on subsonic and supersonic panel methods are appropriate and have been incorporated into these environments. These procedures are called "engineering methods," and they have been combined with structural analyses, design, flight tests, and dynamic simulation to evaluate weapon/aircraft integration issues. An overview of this process is described and examples from actual weapons integration efforts are discussed. It is shown that these modern engineering methods are accurate and efficient, and can be utilized to complement procedures employed for weapons integration. Conclusions, lessons learned, and recommendations for future efforts are emphasized.
Author
Aircraft Configurations; Weapon Systems; Systems Integration; Systems Compatibility; Design Analysis; Multidisciplinary Design Optimization; Applications Programs (Computers)

19990040733 Daimler-Benz Aerospace A.G., Military Aircraft Div., Munich, Germany
Structural Deformation: A New Challenge to the Accuracy of Separation Codes
Deslandes, R., Daimler-Benz Aerospace A.G., Germany; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 23-1 - 23-10; In English; See also 19990040714; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

In general, the state of the art analysis of the separation behaviour of an external store doesn't consider the effects of local structural deformations of the carriage devices and launch equipment. Such deformations may be caused by steady/unsteady inertia and aerodynamic loads. The order of magnitude of such deformations ranges between tenths of degrees up to values of several units. If neglected within the prediction of separation behaviour, a consecutive flight test result normally comes up with a bad evidence. The intention of this paper is to demonstrate such adverse effects which are typical for fighter aircraft carrying external stores. A way ahead will indicate how to overcome these problems by implementing more accurately measured initial conditions into the postflight separation analysis. Thereby store trajectories computed with conventionally gathered initial conditions will be shown in comparison with conditions derived from inflight deformation measurements in order to underline the relevance of such corrections with respect to separation autopilot design and with respect to the clearance work.
Author
External Stores; External Store Separation; Fighter Aircraft; Elastic Deformation; Structural Analysis; Trajectory Analysis; Computerized Simulation; Applications Programs (Computers)

19990040735 Matra BAe Dynamics, Velizy-Villacoublay, France
The Role of the Missileer in the Integration of a Tactical Missile to an Aircraft: The Example of Program 2000-5 *Le Role du Missilier dans une Integration d'un Missile Tactique a un Aeronef: Exemple du Programme 2000-5*
Boischot, M., Matra BAe Dynamics, France; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 25-1 - 25-6; In French; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The complexity of modern armament systems, from the point of view of missiles requires an entire program for the adaptation of a missile to an aircraft, the increasing costs, and the so called separation of missile development. The Matra BAe Dynamics organization has generated a program of integration with a distinct team which is occupied with the development of missiles. We will see that to properly conduct such a program, the early participation of the missileer is necessary in the studies of the employment concept because he provides his knowledge of the missile and his experience with previous adaptations.
Transl. by CASI
Fighter Aircraft; Missile Systems; Systems Integration

19990040772 NASA Langley Research Center, Hampton, VA USA

Overview of Sensitivity Analysis and Shape Optimization for Complex Aerodynamic Configurations

Newman, James C., III, Mississippi State Univ., USA; Taylor, Arthur C., III, Old Dominion Univ., USA; Barnwell, Richard W., Virginia Univ., USA; Newman, Perry A., NASA Langley Research Center, USA; Hou, Gene J.-W., Old Dominion Univ., USA;

Journal of Aircraft; January-February 1999; Volume 36, No. 1, pp. 87-96; In English

Contract(s)/Grant(s): NGT-51247; NAG1-1265; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper presents a brief overview of some of the more recent advances in steady aerodynamic shape-design sensitivity analysis and optimization, based on advanced computational fluid dynamics (CFD). The focus here is on those methods particularly well-suited to the study of geometrically complex configurations and their potentially complex associated flow physics. When nonlinear state equations are considered in the optimization process, difficulties are found in the application of sensitivity analysis. Some techniques for circumventing such difficulties are currently being explored and are included here. Attention is directed to methods that utilize automatic differentiation to obtain aerodynamic sensitivity derivatives for both complex configurations and complex flow physics. Various examples of shape-design sensitivity analysis for unstructured-grid CFD algorithms are demonstrated for different formulations of the sensitivity equations. Finally, the use of advanced, unstructured-grid CFDs in multidisciplinary analyses and multidisciplinary sensitivity analyses within future optimization processes is recommended and encouraged.

Author

Research; Sensitivity; Shapes; Optimization; Aerodynamic Configurations; Design Analysis

19990040796 Geological Survey, Denver, CO USA

Unmanned Airborne Vehicle (UAV): Flight testing and evaluation of two-channel E-field Very Low Frequency (VLF) instrument

Dec. 31, 1998; 9p; In English

Report No.(s): DE99-001103; DOE/OR/22398-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Using VLF frequencies, transmitted by the Navy's network, for airborne remote sensing of the earth's electrical, magnetic characteristics was first considered by the USA Geological Survey (USGS) around the mid 1970s. In the mid 1990s, the Branch of Geophysics designed and developed a two-channel E-field ground portable VLF system. The system was built using state-of-the-art circuit components and new concepts in circuit architecture. Small size, light weight, low power, durability, and reliability were key considerations in the design of the instrument. The primary purpose of the instrument was for collecting VLF data during ground surveys over small grid areas.

NTIS

Measuring Instruments; Flight Tests; Evaluation; Data Acquisition; Pilotless Aircraft

19990040890 Defence Science and Technology Organisation, Maritime Platforms Div., Melbourne, Australia

Residual Stress Measurements and Boeing Wedge Durability Data for the Proposed 470 Bulkhead Bonded Repair

Olsson-Jacques, Christina, Defence Science and Technology Organisation, Australia; November 1998; In English

Report No.(s): DSTO-TN-0178; DODA-AR-010-675; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Fatigue cracking problems have occurred in the F/A-18 470.5 bulkhead during initial full scale testing. The surface of this bulkhead is shot-peened to introduce compressive residual stress to increase the fatigue life of the component as part of the manufacturing and maintenance program. The Aeronautical and Maritime Research Laboratory (AMRL) is investigating the effect of applying a composite patch to reduce the critical strains in the crotch area. Boeing wedge durability tests were used to define the most suitable metal preparation procedure to apply a durable patch to a shotpeened aluminum alloy surface. The x-ray diffraction technique was used to assess any reduction in the beneficial shot-peened residual stress after typical abrasion and heat treatment stages in the preparation procedure. It was found that the abrasion and heat treatment processes used to achieve the most durable surface treatment for bonding did not significantly reduce the beneficial compressive surface stresses induced by the shot-peening process.

Author

Residual Stress; Stress Measurement; Durability; Fatigue Life; Wedges

19990041098 Old Dominion Univ., Aerospace Engineering Dept., Norfolk, VA USA

Effect of Reduced Frequency on Super Maneuver Delta Wing

Abdelhamid, Yahia A., Old Dominion Univ., USA; Kandil, Osama A., Old Dominion Univ., USA; 1998; In English; 36th; Aerospace Sciences, 12-15 Jan. 1998, Reno, NV, USA

Contract(s)/Grant(s): NAG1-648

Report No.(s): AIAA Paper 98-0415; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The unsteady, three-dimensional, Reynolds averaged Navier Stokes equations (NS) are used to simulate and study the flow response around a delta wing undergoing a pitch-up motion up to 90 degrees amplitude. The governing equations are solved time-accurately using the upwind, Roe flux-difference splitting, finite volume scheme. The primary model under consideration consists of a 76 degree swept, sharp-edged delta wing of zero thickness. The Reynolds number and Mach number are 0.45 X 10(exp 6) and .03 respectively. The wing is forced to pitch-up through a ramp function, using a wide range of reduced frequency to provide a good understanding of reduced frequency effect on high amplitude pitch maneuvers. Three reduced frequency values of .0834, 0.134 and 0.04, are used in this study. The computed results are compared with each other as well as the existing experimental data.

Author

Delta Wings; Navier-Stokes Equation; Reynolds Number; Pitch (Inclination); Ramp Functions; Finite Volume Method; Computational Fluid Dynamics; Baldwin-Lomax Turbulence Model; Grid Generation (Mathematics)

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

19990040723 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA

Development, Test and Integration of the AGM-114 Hellfire Missile System and FLIR/Laser on the H-60 Aircraft

Roberts, D., Naval Air Warfare Center, USA; Capezzuto, R., Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 12-1 - 12-12; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The Hellfire Missile System (HMS) and a nose mounted FLIR with laser designator system were selected as integration candidates on H-60 derivatives based on a new fleet weapons requirement. Naval Air Warfare Center Aircraft Division (NAWCAD) Patuxent River conducted ground and flight tests to structurally qualify the HMS and FLIR systems and evaluate their integration into the H-60 airframe. Three ground firings and 45 hours of flight test (including six missile firings and eight launcher jettisons) were conducted in 1995 during the technical feasibility phase and 60 test flight hours were flown in 1997 during the system integration phase. In-flight jettison and missile firing test planning utilized a six degree-of-freedom simulation to develop the minimum number of test points to clear the desired envelope while managing risk. Testing demonstrated the successful structural integration of the HMS and FLIR systems. Testing then proceeded with integration of the functional FLIR and HMS. The integration test program fired 6 missiles at fixed and moving targets, under day and night conditions over land and water using the FLIR/LASER for tracking and autonomous designation. Integration development and testing utilized specialized U.S. Army Hellfire instrumentation as well as the Laser Designator Weapons System Simulator (LDWSS) modeling tool. LDWSS was used to simulate launch conditions and engagement scenarios, predict missile launch transients and trajectories, and identify launch constraint and laser self-designation issues. The simulation tools and test methods employed minimized test flights and required assets, resulting in an efficient certification of this weapon system for fleet use.

Author

H-60 Helicopter; Missile Systems; Systems Integration; Weapons Delivery; Flight Tests; Ballistic Trajectories; Ground Tests; Systems Compatibility; Computerized Simulation; External Store Separation

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19990040175 Environmental Quality Management, Inc., Cincinnati, OH USA
Aircraft Engine and Auxiliary Power Unit Emissions Testing, Volume 3, Particulate Matter Results *Final Report*
Gerstle, Thomas, Environmental Quality Management, Inc., USA; Virage, Peter, Weston (Roy F.), Inc., USA; Wade, Mark, Department of the Air Force, USA; Kimm, Larry, Department of the Air Force, USA; March 1999; 220p; In English
Contract(s)/Grant(s): F41624-95-D-9019
Report No.(s): AD-A361473; IERA-RS-BR-TR-1999-0006-V-3; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This report is the product of a 2-year emissions testing program designed to document, characterize, and evaluate emissions from sixteen aircraft engines, two helicopter engines, and two auxiliary power units (APUs) burning JP-8 fuel. The purpose of this engine testing program was to develop emission factors for the tested engines under representative engine load conditions. All testing was performed by the Environmental Quality Management Inc. (EQ) and Roy F. Weston, Inc. (Weston) team. Testing was conducted for criteria pollutants and select hazardous air pollutants (HAPs), e.g., aldehyde/ketones and semi volatile and volatile organic compounds.

DTIC

Aircraft Engines; Helicopter Engines; Exhaust Emission; Environmental Quality; Engine Tests; Combustion

19990040176 Environmental Quality Management, Inc., Cincinnati, OH USA
Aircraft Engine and Auxiliary Power Unit Emissions Testing, Volume 1, Executive Summary *Final Report*
Gerstle, Thomas, Environmental Quality Management, Inc., USA; Virage, Peter, Weston (Roy F.), Inc., USA; Wade, Mark, Department of the Air Force, USA; Kimm, Larry, Department of the Air Force, USA; March 1999; 56p; In English
Contract(s)/Grant(s): F41624-95-D-9019
Report No.(s): AD-A361474; IERA-RS-BR-TR-1999-0006-V-1; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report is the product of a 2-year emissions testing program designed to document, characterize, and evaluate emissions from sixteen aircraft engines, two helicopter engines, and two auxiliary power units (APUs) burning JP-8 fuel. The purpose of this engine testing program was to develop emission factors for the tested engines under representative engine load conditions. All testing was performed by the Environmental Quality Management Inc. (EQ) and Roy F. Weston, Inc. (Weston) team. Testing was conducted for criteria pollutants and select hazardous air pollutants (HAPs), e.g., aldehyde/ketones and semivolatile and volatile organic compounds.

DTIC

Aircraft Engines; Environmental Quality; Exhaust Emission; Engine Tests; Emission

19990040177 Environmental Quality Management, Inc., Cincinnati, OH USA
Aircraft Engine and Auxiliary Power Unit Emissions Testing,, Volume 2, Detailed Sampling Approach and Results *Final Report*
Gerstle, Thomas, Environmental Quality Management, Inc., USA; Virage, Peter, Weston (Roy F.), Inc., USA; Wade, Mark, Department of the Air Force, USA; Kimm, Larry, Department of the Air Force, USA; March 1999; 1384p; In English
Contract(s)/Grant(s): F41624-95-D-9019
Report No.(s): AD-A361475; IERA-RS-BR-TR-1999-0006-V-2; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

This report is the product of a 2-year emissions testing program designed to document, characterize, and evaluate emissions from sixteen aircraft engines, two helicopter engines, and two auxiliary power units (APUs) burning JP-8 fuel. The purpose of this engine testing program was to develop emission factors for the tested engines under representative engine load conditions. All testing was performed by the Environmental Quality Management Inc. (EQ) and Roy F. Weston, Inc. (Weston) team. Testing was conducted for criteria pollutants and select hazardous air pollutants (HAPs), e.g., aldehyde/ketones and semi- volatile and volatile organic compounds.

DTIC

Aircraft Engines; Exhaust Emission; Design Analysis; Environmental Quality; Air Pollution

19990040657 NASA Glenn Research Center, Cleveland, OH USA

Real-Time Optical Fuel-to-Air Ratio Sensor for Gas Turbine Combustors

Nguyen, Quang-Viet, NASA Glenn Research Center, USA; Mongia, Rajiv K., California Univ., USA; Dibble, Robert W., California Univ., USA; March 1999; 10p; In English

Contract(s)/Grant(s): RTOP 523-36-13

Report No.(s): NASA/TM-1999-209041; NAS 1.15:209041; E-11566; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The measurement of the temporal distribution of fuel in gas turbine combustors is important in considering pollution, combustion efficiency and combustor dynamics and acoustics. Much of the previous work in measuring fuel distributions in gas turbine combustors has focused on the spatial aspect of the distribution. The temporal aspect however, has often been overlooked, even though it is just as important. In part, this is due to the challenges of applying real-time diagnostic techniques in a high pressure and high temperature environment. A simple and low-cost instrument that non-intrusively measures the real-time fuel-to-air ratio (FAR) in a gas turbine combustor has been developed. The device uses a dual wavelength laser absorption technique to measure the concentration of most hydrocarbon fuels such as jet fuel, methane, propane, etc. The device can be configured to use fiber optics to measure the local FAR inside a high pressure test rig without the need for windows. Alternatively, the device can readily be used in test rigs that have existing windows without modifications. An initial application of this instrument was to obtain time-resolved measurements of the FAR in the premixer of a lean premixed prevaporized (LPP) combustor at inlet air pressures and temperatures as high as 17 atm at 800 K, with liquid JP-8 as the fuel. Results will be presented that quantitatively show the transient nature of the local FAR inside a LPP gas turbine combustor at actual operating conditions. The high speed (kHz) time resolution of this device, combined with a rugged fiber optic delivery system, should enable the realization of a flight capable active-feedback and control system for the abatement of noise and pollutant emissions in the future. Other applications that require an in-situ and time-resolved measurement of fuel vapor concentrations should also find this device to be of use.

Author

Real Time Operation; Optical Equipment; Fuel-Air Ratio; Gas Turbines; Combustion Chambers; Active Control; Exhaust Emission

19990040966 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Fishermens Bend, Australia

Simulation and Modelling of Reacting Particles Relevant to Gas Turbine Engine Combustion

Smith, Nigel S. A., Defence Science and Technology Organisation, Australia; December 1998; In English

Report No.(s): DSTO-RR-0142; DODA-AR-010-688; Copyright; Avail: Issuing Activity (DSTO, Aeronautical and Maritime Research Lab., 506 Lorimer St., Fishermens Bend, Victoria, Australia 3207), Hardcopy, Microfiche

A conditional moment closure model is proposed for reacting particles in turbulent nonpremixed combustion. The new model for particles differs significantly from the traditional uniform diffusivity gas-phase conditional moment closure model. The new features of the model and model effectiveness are examined against direct numerical simulation data for soot-like and droplet-like particles in turbulent nonpremixed combustion. The influence of differing particle sizes, types, and reactivity on the effectiveness of the model closure is examined in detail.

Author

Models; Direct Numerical Simulation; Reactivity; Drops (Liquids); Soot

19990041065 NASA Lewis Research Center, Cleveland, OH USA

Hsub infinity) Control Design for a Jet Engine

Adibhatla, Shrider, General Electric Co., USA; Garg, Sanjay, NASA Lewis Research Center, USA; Collier, George J., General Electric Co., USA; Zhao, Xin, General Electric Co., USA; 1998; In English; Propulsion, 12-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 98-3753; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper deals with the application of advanced multivariable control technologies to jet engines. These technologies include a modified Hsub infinity) technique, techniques for reducing the order of the controller, a simplified gain scheduling technique, and an integrator windup protection scheme. Application of these techniques to a variable cycle engine is described. A graphical user that simplified the design and code maintenance process was used for all the design work. Results of evaluation using linear and nonlinear models are summarized. A new order reduction technique is presented. The impact of unintended differ-

ences in the design and test models is explained. The techniques used all worked well, except for the integrator windup scheme, which needs further work.
Author
Jet Engines; Variable Cycle Engines; Multivariable Control

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities, piloting, flight controls, and autopilots.

19990040770 Old Dominion Univ., Aerospace Engineering Dept., Norfolk, VA USA
Coupled and Uncoupled Bending-Torsion Responses of Twin-Tail Buffet
Kandil, O. A., Old Dominion Univ., USA; Sheta, E. F., Old Dominion Univ., USA; Journal of Fluids and Structures; 1998; ISSN 0889-9746; Volume 12, Article f1980168, pp. 677-701; In English
Contract(s)/Grant(s): NAG1-648; NAG1-994; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The effect of coupled and uncoupled bending and torsion modes on flexible twin-tail buffet is considered. This multidisciplinary problem is investigated using three sets of equations on a multi-block grid structure. The first set is the unsteady, compressible, laminar full Navier-Stokes equations which are used for obtaining the flow-filed vector and the aerodynamic loads on the twin tails. The second set is the coupled aeroelastic equations which are used for obtaining the bending and torsional deflections of the twin tails. The third set is the grid-displacement equations which are used for updating the grid coordinates due to the tail deflections. The configuration is pitched at 30 deg. angle of attack and the free-stream Mach number and Reynolds number are 0.3 and 1.25 million, respectively. Keeping the twin tails as rigid surfaces, the problem is solved for the initial flow conditions. Next, the problem is solved for the flexible twin-tail responses due to the unsteady loads produced by the vortex breakdown flow of the delta-wing leading-edge vortex cores. The configuration is investigated for the effect of coupled and uncoupled bending and torsion modes, using two different separation distances of the twin-tail; the inboard and the outboard positions. The computational results are in good with the experimental data.
Author
Buffeting; Couplers; Bending; Torsion; Tail Assemblies; Uncoupled Modes; Loads (Forces); Delta Wings; Aeroelasticity

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19990039565 Raytheon Training and Services Co., Mesa, AZ USA
M2DART: A Real-Image Simulator Visual Display System *Final Report, Jul. 1997 - Sep. 1998*
Wight, Donal R.; Best, Leonard G.; Peppler, Philipp W.; Nov. 1998; 16p; In English
Contract(s)/Grant(s): F41624-97-D-5000; AF Proj. 2743
Report No.(s): AD-A361265; AFRL-HE-AZ-TR-1998-0097; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the Mobile Modular Display for Advanced Research and Training (M2DART) that was designed and fabricated at the Air Force Research Laboratory's Warfighter Training Research Division in Mesa, Arizona. The M2DART is an eight-channel, state-of-the-art, real-image, rear-projection, visual display system. It is a full-color, high-resolution, wraparound display system designed for use with single-seat cockpit simulators. This report provides a system description, which includes hardware configuration, screen geometry, field of view, spatial resolution, luminance, and contrast values.
DTIC
Flight Simulators; Display Devices; Design Analysis; Fabrication

19990040337 NASA Marshall Space Flight Center, Huntsville, AL USA
An Overview of the Electrostatic Levitation Facility at NASA's Marshall Space Flight Center
Rogers, Jan R., NASA Marshall Space Flight Center, USA; Robinson, Michael B., NASA Marshall Space Flight Center, USA; Savage, Larry, NASA Marshall Space Flight Center, USA; Soellner, Wolfgang, Raytheon Co., USA; Huie, Doug, Mevatec Corp., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 561; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche; Abstract Only; Abstract Only

Containerless processing represents an important area of research in microgravity materials science. This method provides access to the metastable state of an undercooled melt. Containerless processing provides a high-purity environment for the study of reactive, high-temperature materials. Reduced gravity affords several benefits for containerless processing; for example, greatly reduced positioning forces are required and therefore samples of greater mass can be studied. Additionally, in reduced gravity larger specimens will maintain spherical shape which will facilitate modeling efforts. Space Systems/LORAL developed an Electrostatic Containerless Processing System (ESCAPES) as a materials science research tool for investigations of refractory solids and melts. ESCAPES is designed for the investigation of thermophysical properties, phase equilibria, metastable phase formation, undercooling and nucleation, time-temperature-transformation diagrams, and other aspects of materials processing. These capabilities are critical to the research programs of several Principal Investigators supported by the Microgravity Materials Science Program of NASA. NASA's Marshall Space Flight Center (MSFC) recently acquired the ESCAPES system from LORAL. MSFC is now developing a levitation facility in order to provide a critical resource to the microgravity materials science research community and to continue and enhance ground-based research in the support of the development of flight experiments during the transition to Space Station.
Derived from text
Test Facilities; Levitation; Electrostatics; Microgravity

19990040402 Biodynamic Research Corp., San Antonio, TX USA
Model Validation and Design for the Dynamic Environment Simulator, Phase 2 *Final Report, May 1996 - Sep. 1998*
van Poppel, Jon A.; Pancratz, David J.; Rangel, Mike H.; Barton, Brian J.; Banks, Robert D.; Sep. 1998; 131p; In English
Contract(s)/Grant(s): F41624-96-C-6027
Report No.(s): AD-A361235; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report describes all SBIR Phase 2 effort to validate a mathematical model mid conduct a design study of the Air Force Dynamic Environment Simulator. The Dynamic Environment Simulator, or DES, is a three degree-of-freedom centrifuge operated by Armstrong Laboratories at Wright-Patterson AFB. The effort was conducted under Contract F41624-96-C-6027 through the Armstrong Laboratory and was entitled "Model Validation and Design Study of the Dynamic Environment Simulator." This Phase 2 project had four primary objectives, which were to: (1) Validate the Phase 1 software model of the DES; (2) Conduct a design study of DES improvements; (3) Perform a cost/benefit analysis of the possible DES improvements; and (4) Demonstrate the commercial potential of the model and the DES.
DTIC
Software Engineering; Mathematical Models; Degrees of Freedom; Computer Program Integrity

19990040651 Army Construction Engineering Research Lab., Champaign, IL USA
Case Study: Structural Evaluation of Steel Truss Aircraft Hangars at Corpus Christi Army Depot, Texas *Final Report*
Al-Chaar, Ghassan K.; Ericksen, Jason; Desai, Pramod; Feb. 1999; 723p; In English
Report No.(s): AD-A361006; CERL-TR-99/27; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

A number of steel truss aircraft hangars at Corpus Christ Army Depot (CCAD) are similar to those that have performed poorly during recent hurricanes in other parts of the country. Engineering analysis of such structures currently in use can identify structural vulnerabilities, and retrofit schemes may be developed to reduce or eliminate these vulnerabilities to severe wind loads. The objective of this work was to evaluate the structural adequacy of four steel truss aircraft hangars at CCAD by conducting structural analyses using the most recent building code guidelines. State-of-the-art data on the behavior of steel structures under dynamic loads were utilized. The current conditions of CCAD aircraft hangars 43, 44, 45, and 47 were evaluated. Structural deficiencies and overstressed members and joints were identified, and retrofit methods to meet the requirements of current codes were developed. Exhaustive data from the engineering analyses are included, and specific recommendations for retrofit are presented.
DTIC
Hangars; Steel Structures; Structural Analysis; Trusses

11
CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19990040224 CSA Engineering, Inc., Engineering Services in Structural Dynamics, Palo Alto, CA USA
Analysis and Test Support for Phillips Laboratory Precision Structures
Goodding, James, CSA Engineering, Inc., USA; November 1998; 20p; In English
Contract(s)/Grant(s): F33615-94-C-3200
Report No.(s): AD-A361477; CSA-98-11-02; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report documents work performed for the Aerospace Structures Information and Analysis Center (ASIAC) under ASIAC Task 35, "Analysis and Test support for Phillips Laboratory Precision Structures." Mr. James Goodding of CSA Engineering was the principal investigator for this task. Mr. Goodding is an integral team member on a number of experiments at the Air Force Research Laboratory (AFRL), Phillips Research Site. Task objectives centered around analysis and structural dynamic test support on experiments within the Space Vehicles Directorate at Kirtland Air Force Base. These efforts help to augment the Air Force's understanding of advanced technology devices and interactions with aerospace structures. One of the programs supported in this task was the Vibration Isolation and Suppression System (VISS), an AFRL experiment that will fly as part of the Space Technology Research Vehicle-2 (STRV-2) mission. VISS will demonstrate state-of- the-art vibration mitigation technologies for a satellite-based observation platform. Activities included environmental flight qualification test support and participation in the performance test program. The performance testing characterized both open and closed-loop dynamics used to implement the control laws. The Satellite Ultraquiet Isolation Technology Experiment (SUITE) is another AFRL experiment with many of the same objectives as VISS. Efforts in Task 35 included hardware and software development of the sophisticated active system experiment. Additional efforts included flight hardware acceptance test support for vibration and thermal/vacuum environments prior to delivery to Surrey Satellite Technology Limited (SSTL) for spacecraft integration. Assistance to the UltraLITE program was included in this effort. UltraLiTE will demonstrate the capability to control deployable space structures to nanometer accuracy in the laboratory.
DTIC
Vibration Isolators; Aircraft Structures; Dynamic Tests; Feedback Control; Performance Tests; Aerospace Engineering; Observation; Isolation

19990040179 NASA Langley Research Center, Hampton, VA USA
Evaluation of the Compressive Response of Notched Composite Panels Using a Full-Field Displacement Measurement System
McGowan, David M., NASA Langley Research Center, USA; Ambur, Damodar R., NASA Langley Research Center, USA; Hanna, T. Glen, South Carolina Univ., USA; McNeill, Stephen R., South Carolina Univ., USA; 1999; In English
Report No.(s): AIAA Paper 99-1406; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental and analytical evaluation of the compressive response of two composite, notched stiffened panels representative of primary composite wing structure is presented. A three-dimensional full-field image correlation technique is used to measure all three displacement components over global and local areas of the test panels. Point-wise and full-field results obtained using the image correlation technique are presented and compared to experimental results and analytical results obtained using nonlinear finite element analysis. Both global and global-local image correlation results are presented and discussed. Results of a simple calibration test of this image correlation technique are also presented.
Author
Displacement Measurement; Graphite-Epoxy Composites; Composite Structures; Wing Panels

12
ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19990040891 Royal Melbourne Inst. of Tech., Sir Lawrence Wackett Centre for Aerospace Design Technology, Australia
Wing in Ground Effect Craft Review
Halloran, Michael, Royal Melbourne Inst. of Tech., Australia; OMeara, Sean, Royal Melbourne Inst. of Tech., Australia; February 1999; In English
Report No.(s): RMIT-CR-9802; DSTO-GD-0201; DODA-AR-010-831; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

It has long been recognized that flight close to a boundary surface is more aerodynamically efficient than flight in the free-stream. This has led to the design and construction of craft specifically intended to operate close to the ground and fly 'in ground effect'. A great range of Wing in Ground effect craft (WIGS) have been manufactured ranging from 2 seat recreational vehicles to 500 tonn warcraft. Despite this WIGs have never enjoyed great commercial or military success. The Maritime Platform Division of DSTO commissioned The Sir Lawrence Wackett Centre for Aerospace Design Technology to conduct a design review of WIG craft. This review considers all elements of WIG design and operation, including performance, limitations, control, stability, operational requirements, regulation, manufacture and technological risk. The review highlights the research required to overcome the weaknesses of WIG craft, the advantages that they may offer and the possible uses of WIG craft in the Australian military. Author

Wings; Ground Effect (Aerodynamics); Design Analysis; Control Stability

19990038384 Federal Aviation Administration, Research and Special Programs Administration, Cambridge, MA USA
Pilot-Controller Communication Errors: An Analysis of Aviation Safety Reporting System (ASRS) Reports *Final Report, Jul. 1991 - May 1996*
Cardosi, Kim; Falzarano, Paul; Han, Sherwin; Jan. 1999; 37p; In English
Report No.(s): AD-A361542; DOT-VNTSC-FAA-98-4; DOT/FAA/AR-98/17; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this study was to identify the factors that contribute to pilot-controller communication errors. Reports submitted to the Aviation Safety Reporting System (ASRS) offer detailed accounts of specific types of errors and a great deal of insight as to why they occur. The communication errors found in this study could be classified into three types: Readback/hearback errors (the pilot reads back the clearance incorrectly and the controller fails to correct the error), the absence of a pilot readback,and Hearback Errors Type II (the controller fails to notice his or her own error in the pilot's correct readback). In the 386 reports analyzed, the most common contributing factors were: similar call signs on the same frequency, pilot expectations (e.g., accepting a clearance that they expected rather than what the controller actually said), and high controller workload. The identified results of these communication errors were (in order of prominence): altitude deviations, loss of standard separation, ATC operational errors, pilots landing on the wrong runway, and runway transgressions. The report concludes with recommendations for reducing the number of communication errors between pilots and controllers.
DTIC

Errors; Aircraft Safety; Pilots (Personnel); Flight Control; Voice Communication

19990040164 AYT Corp., Cleveland, OH USA
Heat Transfer on a Film-Cooled Rotating Blade Using a Two Equation Turbulence Model
Garg, Vijay K., AYT Corp., USA; International Journal of Rotating Machinery; 1998; Volume 4, No. 3, pp. 201-216; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A three-dimensional Navier-Stokes code has been used to compare the heat transfer coefficient on a film-cooled, rotating turbine blade. The blade chosen is the ACE rotor with five rows containing 93 film cooling holes covering the entire span. This is the only film-cooled rotating blade over which experimental data is available for comparison. Over 2.278 million grid points are used to compute the flow over the blade including the tip clearance region, using Coakley's q-omega turbulence model. Results are also compared with those obtained by Garg and Abhari (1997) using the zero-equation Baldwin-Lomax (B-L) model. A reasonably good comparison with the experimental data is obtained on the suction surface for both the turbulence models. At the leading edge, the B-L model yields a better comparison than the q-omega model. On the pressure surface, however, the comparison between the experimental data and the prediction from either turbulence model is poor. A potential reason for the discrepancy on

the pressure surface could be the presence of unsteady effects due to stator-rotor interaction in the experiments which are not modeled in the present computations. Prediction using the two-equation model is in general poorer than that using the zero-equation model, while the former requires at least 40% more computational resources.
Author
Baldwin-Lomax Turbulence Model; Heat Transfer; Film Cooling; Turbine Blades; Turbulence Models; Rotary Wing Aircraft; Supersonic Turbines; Stator Blades

19990041087 NASA Lewis Research Center, Cleveland, OH USA
Influence of Gear Design on Gearbox Radiated Noise
Oswald, Fred B., NASA Lewis Research Center, USA; Townsend, Dennis P., NASA Lewis Research Center, USA; Valco, Mark J., Army Research Lab., USA; Spencer, Robert H., Boeing Helicopter Co., USA; Drago, Raymond J., Boeing Helicopter Co., USA; Lenski, Joseph W., Jr., Boeing Helicopter Co., USA; Gear Technology; Jan.-Feb. 1998, pp. 10-15; In English
Contract(s)/Grant(s): NAS3-25421; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A major source of helicopter cabin noise (which has been measured at over 100 decibels sound pressure level) is the gearbox. Reduction of this noise is a NASA and U.S. Army goal. A requirement for the Army/NASA Advanced Rotorcraft Transmission project was a 10 dB noise reduction compared to current designs The main exciting forces which produce gear noise are the meshing forces of the gear teeth in the transmission. While many factors influence transmission noise, the simple fact remains that if the basic exciting forces are reduced and no amplifying factors are present, the overall noise level of the system will be reduced. Among the several ways in which the gear tooth meshing forces may be reduced, two of the most directly applicable to helicopter transmissions are the form of the teeth and the overall contact ratio. Nine different spur and helical gear designs were tested in the NASA gear-noise rig to compare the noise radiated from the gearbox top for the various gear designs. Sound power measurements were made under controlled conditions for a matrix of opening conditions.
Derived from text
Acoustic Measurement; Aircraft Noise; Gear Teeth; Noise Reduction; Transmissions (Machine Elements)

19990039289 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Development and validation of nondestructive inspection techniques for composite doubler repairs on commercial aircraft
Roach, D., Department of Energy, USA; Walkington, P., Department of Energy, USA; May 31, 1998; 170p; In English
Report No.(s): DE98-005803; SAND-98-1014; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Composite doublers, or repair patches, provide an innovative repair technique which can enhance the way aircraft are maintained. Instead of riveting multiple steel or aluminum plates to facilitate an aircraft repair, it is possible to bond a single boron-epoxy composite doubler to the damaged structure. In order for the use of composite doublers to achieve widespread use in the civil aviation industry, it is imperative that methods be developed which can quickly and reliably assess the integrity of the doubler. In this study, a specific composite application was chosen on an L-1011 aircraft in order to focus the tasks on application and operation issues. Primary among inspection requirements for these doublers is the identification of disbonds, between the composite laminate and aluminum parent material, and delaminations in the composite laminate. Surveillance of cracks or corrosion in the parent aluminum material beneath the doubler is also a concern. No single nondestructive inspection (NDI) method can inspect for every flaw type, therefore it is important to be aware of available NDI techniques and to properly address their capabilities and limitations. A series of NDI tests were conducted on laboratory test structures and on full-scale aircraft fuselage sections. Specific challenges, unique to bonded composite doubler applications, were highlighted. An array of conventional and advanced NDI techniques were evaluated. Flaw detection sensitivity studies were conducted on applicable eddy current, ultrasonic, X-ray and thermography based devices. The application of these NDI techniques to composite doublers and the results from test specimens, which were loaded to provide a changing flaw profile, are presented in this report. It was found that a team of these techniques can identify flaws in composite doubler installations well before they reach critical size.
NTIS
Composite Materials; Procedures; Nondestructive Tests; Aircraft Maintenance; Boron-Epoxy Composites; Proving

13
GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

19990040811 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Molten carbonate fuel cell product development test *Final Report, 30 Sep. 1992 - 31 Mar. 1997*
Dec. 31, 1997; 93p; In English
Report No.(s): DE98-058028; DOE/MC/28065-1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report summarizes the work performed for manufacturing and demonstrating the performance of its 250-kW molten carbonate fuel cell (MCFC) stack in an integrated system at the Naval Air Station Miramar (NAS Miramar) located in San Diego, California. The stack constructed for the demonstration test at the NAS Miramar consisted of 250 cells. It was manufactured using M-C Power's patented Internally Manifolded Heat Exchanger (IMHEX(reg-sign)) stack design. The demonstration test at NAS Miramar was designed to operate the 250-kW MCFC stack in a cogeneration mode. This test represented the first attempt to thermally integrate an MCFC stack in a cogeneration system. The test produced 160 MWh of d.c. power and 346,000 lbs of 110 psig steam for export during 1,566 hours of on-load operations. The test demonstrated a d.c. power output of 206 kW. Most of the balance of the plant (BOP) equipment operated satisfactorily. However, the off-the-shelf automotive turbocharger used for supplying air to the plant failed on numerous occasions and the hot gas blower developed seal leakage problems which impacted continuous plant operations. Overall the demonstration test at NAS Miramar was successful in demonstrating many critical features of the IMHEX technology.
NTIS
Product Development; Performance Tests; Heat Exchangers; High Temperature Gases; Molten Carbonate Fuel Cells; Superchargers

19990040662 NASA Goddard Space Flight Center, Greenbelt, MD USA
Aircraft NO(x) had no Unique Fingerprint on Sonex: Lightning Dominated Fresh NO(x) Sources
Thompson, A., NASA Goddard Space Flight Center, USA; Sparling, L., NASA Goddard Space Flight Center, USA; Kondo, Y., NASA Goddard Space Flight Center, USA; Anderson, B., NASA Goddard Space Flight Center, USA; Gregory, G., NASA Goddard Space Flight Center, USA; Sachse, G., NASA Goddard Space Flight Center, USA; Mar. 04, 1999; 12p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Key questions to which SONEX was directed were the following: Can aircraft corridors be detected? Is there a unique tracer for aircraft NO(x)? Can a "background" NO(x) (or NO(y) be defined? What fraction of NO(x) measured during SONEX was from aircraft? How representative was SONEX of the North Atlantic in 1997 and how typical of other years? We attempt to answer these questions through species-species correlations, probability distribution functions (PDFs), and meteorological history. There is not a unique aircraft tracer, largely due to the high variability of air mass origins and tracer ratios, which render "average" quantities meaningless. The greatest NO and NO(y) signals were associated with lightning and convective NO sources. Well-defined background CO, NO(y) and NO(y)/ozone ratio appear in subsets of two cross-track flights with subtropical origins and five flights with predominantly mid-latitude air. Forty percent of the observations on these 7 flights showed NO(y)/ozone to be above background, evidently due to unreacted NO(x). This NO(x) is a combination of aircraft, lightning and surface pollution injected by convection. The strongly subtropical signatures in SONEX observations, confirmed by pv (potential vorticity) values along flight tracks, argues for most of the unreacted NO(x) originating from lightning. Potential vorticity statistics along SONEX flight tracks in 1992-1998, and for the North Atlantic as a whole, show the SONEX meteorological environment to be representative of the North Atlantic flight corridor in the October-November period.
Author
Nitrogen Oxides; Signatures; Probability Distribution Functions; Ozone; Mass Ratios; Flight Hazards; Air Masses

19990039555 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
A Comparison of Horizontal Cloud-to-Ground Lightniag Flash Distance Using Weather Surveillance Radar and The Distance Between Successive Flashes Method *Final Report*
Cox, Christopher C.; Mar. 1999; 147p; In English
Report No.(s): AD-A361389; AFIT/GM/ENP/99M-03; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

On April 29th, 1996 an airman servicing a C-130 aircraft on Huriburt AFB Florida was struck and killed by a lightning flash that traveled an estimated 7 to 10 miles from storms south of the airfield. Ten other workers were injured in the incident. The fatal flash occurred just 8 minutes after the base weather station allowed a lightning advisory to expire. The incident brought to question

the adequacy of lightning advisory criteria. Very little research has been done on the horizontal distance that cloud-to-ground lightning flashes occurs from the center of a thunderstorm. This thesis used the WSR-88D method, which used the WSR-88D Algorithm Testing and Display System (WATADS) to calculate the distance from a lightning flash to a thunderstorm centroid. The WSR-88D method was compare with a lightning spatial and temporal clustering method known as the Distance Between Successive Flashes (DBSF) method. This method can use enormous amounts of lightning data, and is well suited to accomplish a climatology of horizontal flash distance from a lightning centroid. For the combined April and July 1996 data used in this thesis, the average percentage of lightning flashes that occurred beyond the 5 nautical mile lightning safety radius outlined in AFOSH 91-100 for both the WSR-88D method and the DBSF method was 30.86%. This result questions the adequacy of the 5 nautical mile lightning safety distance criterion currently being used at most USA Air Force Bases for protection both life and property.
DTIC
Lightning; Range; Thunderstorms; C-130 Aircraft

14
LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

19990039548 Army Aeromedical Research Lab., Fort Rucker, AL USA
Evaluation of a Standardized Spatial Disorientation Flight Profile
Feb. 1999; 20p; In English
Report No.(s): AD-A361470; USAARL-99-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This study was designed to examine the feasibility of using visual-vestibular mismatch software to produce disorienting events in flight within a standardized simulator flight profile. Data were examined in order to ensure that collection of standard flight performance measures was not interrupted by the addition of disorienting events. Twenty-one UH-60 qualified Army aviators flew a 1-hour UH-60 simulator flight profile containing three visual-vestibular mismatch events (visual and vestibular divergence used, 4 degrees per sec with pitch, 6 degrees per sec with roll, and 8 degrees per sec with drift). Following the flight, aviators filled out a simulator sickness questionnaire and rated each event in terms of difficulty of aircraft control recovery.
DTIC
Flight Characteristics; Aircraft Control; Disorientation; Motion Sickness

19990040218 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Aviator Behavior and Performance as Affected by Aircrew Life Support and Protective Equipment
Waugh, John D.; Fatkin, Linda T.; Patton, Debra J.; Mullins, Linda L.; Burton, Pamela A.; Mar. 1999; 110p; In English; Original contains color plates
Contract(s)/Grant(s): Proj-1L161110274A
Report No.(s): AD-A361321; ARL-MR-440; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A methodology for quantifying Army rotary wing aviator performance as influenced by aircrew life support, survival, and nuclear-biological-chemical clothing and equipment ensembles was examined in a set of experimental trials conducted in an AH-64 (Apache) combat mission simulator. The methodology was based on an aircrew evaluation procedure originally developed for use in the crew coordination training of all Army aviators. It uses a set of 13 basic qualities, each with behavioral anchors and a 7-point rating scale, and it is administered by specifically trained senior aviator evaluators. Ten crews, two aviators in each, while fully encumbered, performed three combat missions for record, representative of typical operational tasks, with one "variation" trial conducted without the over-water components of the ensemble. Measures of effectiveness and flight data, as well as stress assessment and equipment "complaints" citations, were recorded. The results indicated that the behavior-anchored scores were not sensitive enough to statistically discriminate among the independent variables of repeated measures and the variation trials even though graphically, differences were readily apparent. Attempts to apply transformations to the data, based on the aviator subjects' relative flying experience and their apparent accommodation to the trials were also statistically unsuccessful. The additional measures collected did not yield statistically significant discriminations nor did they correlate well with the evaluation score. A number of options for improving the technique are offered.
DTIC
Protective Clothing; Aircraft Pilots

19990040400 Armstrong Lab., Aerospace Medicine Directorate, Brooks AFB, TX USA

Testing and Evaluation of the Modified Gentex Mask Assembly in the Hyperbaric Environment *Final Report, Feb. 1996 - Apr. 1997*

Massa, Thomas V.; Apr. 1998; 20p; In English

Report No.(s): AD-A361226; AL-AO-BR-TR-1998-0038; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Since the late 1970's Air Force hyperbaric facilities have been utilizing the MBU 5/P aviator's mask with a unique hyperbaric adapter assembly as a way to safely exhaust exhaled breathing gas from inside a high pressure chamber to ground level ambient pressure. Although the MBU 5/P mask, developed in the 1950's, is still available through depot, the modified adapter assembly is not. In order to purchase additional units, the adapter assembly must be re-milled at considerable expense to the government. Recently developed mask technology has evolved new systems which may provide increased comfort and reduced maintenance at less cost to the government. The Modified Gentex Mask Assembly (MGMA) was evaluated by hyperbaric technologists at 3.0, 2.4 and 2.0 ATA using a pressure demand regulator, pressure transducers and a mass spectrometer to determine if the MGMA could physiologically maintain levels of inspired oxygen while also exhausting expired carbon dioxide and other exhaled gases to ambient pressure. Equipment testing has identified the MGMA as a suitable substitute for implementation at Air Force and possibly civilian hyperbaric facilities. Inspiratory and expiratory gas analysis indicate the MGMA and current A-14 regulator constitute a highly efficient oxygen delivery system for hyperbaric use. MGMA met or exceeded industry standards established by Sheffield, Stork and Morgan. Currently, the MGMA is being modified for improvements by the Gentex Corporation.

DTIC

Oxygen Masks; Oxygen Supply Equipment; Aircraft Pilots; Breathing Apparatus; Gas Mixtures

15
MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19990040594 NASA Langley Research Center, Hampton, VA USA

Large-Scale Parallel Unstructured Mesh Computations for 3D High-Lift Analysis

Mavriplis, D. J., Institute for Computer Applications in Science and Engineering, USA; Pirzadeh, S., NASA Langley Research Center, USA; 1999; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 99-0537; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A complete "geometry to drag-polar" analysis capability for three-dimensional high-lift configurations is described. The approach is based on the use of unstructured meshes in order to enable rapid turnaround for complicated geometries which arise in high-lift configurations. Special attention is devoted to creating a capability for enabling analyses on highly resolved grids. Unstructured meshes of several million vertices are initially generated on a work-station, and subsequently refined on a supercomputer. The flow is solved on these refined meshes on large parallel computers using an unstructured agglomeration multigrid algorithm. Good prediction of lift and drag throughout the range of incidences is demonstrated on a transport take-off configuration using up to 24.7 million grid points. The feasibility of using this approach in a production environment on existing parallel machines is demonstrated, as well as the scalability of the solver on machines using up to 1450 processors.

Author

Computational Fluid Dynamics; Computational Grids; Unstructured Grids (Mathematics); Grid Generation (Mathematics); Aerodynamic Drag; Lift

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TFaNS Tone Fan Noise Design/Prediction System, Volume I: System Description, CUP3D Technical Documentation and Manual for Code Developers *Final Report*

Topol, David A., United Technologies Corp., USA; March 1999; 78p; In English

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TFaNS is the Tone Fan Noise Design/Prediction System developed by Pratt & Whitney under contract to NASA Lewis (presently NASA Glenn). The purpose of this system is to predict tone noise emanating from a fan stage including the effects of reflection and transmission by the rotor and stator and by the duct inlet and nozzle. These effects have been added to an existing annular duct/isolated stator noise prediction capability. TFaNS consists of: The codes that compute the acoustic properties (reflection and transmission coefficients) of the various elements and write them to files. Cup3D: Fan Noise Coupling Code that reads these files, solves the coupling problem, and outputs the desired noise predictions. AWAKEN: CFD/Measured Wake Postprocessor which reformats CFD wake predictions and/or measured wake data so it can be used by the system. This volume of the report provides technical background for TFaNS including the organization of the system and CUP3D technical documentation. This document also provides information for code developers who must write Acoustic Property Files in the CUP3D format. This report is divided into three volumes: Volume I: System Description, CUP3D Technical Documentation, and Manual for Code Developers; Volume II: User's Manual, TFaNS Vers. 1.4; Volume III: Evaluation of System Codes.

Author

Acoustic Properties; Aerodynamic Noise; Noise Prediction (Aircraft); Aircraft Noise; Rotor Blades (Turbomachinery); Stator Blades

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Acoustic Scattering by Three-Dimensional Stators and Rotors Using the SOURCE3D Code, Volume I, Analysis and Results

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This report provides a study of rotor and stator scattering using the SOURCE3D Rotor Wake/Stator Interaction Code. SOURCE3D is a quasi-three-dimensional computer program that uses three-dimensional acoustics and two-dimensional cascade load response theory to calculate rotor and stator modal reflection and transmission (scattering) coefficients. SOURCE3D is at the core of the TFaNS (Theoretical Fan Noise Design/Prediction System), developed for NASA, which provides complete fully coupled (inlet, rotor, stator, exit) noise solutions for turbofan engines. The reason for studying scattering is that we must first understand the behavior of the individual scattering coefficients provided by SOURCE3D, before eventually understanding the more complicated predictions from TFaNS. to study scattering, we have derived a large number of scattering curves for vane and blade rows. The curves are plots of output wave power divided by input wave power (in dB units) versus vane/blade ratio. Some of these plots are shown in this report. All of the plots are provided in a separate volume. to assist in understanding the plots, formulas have been derived for special vane/blade ratios for which wavefronts are either parallel or normal to rotor or stator chords. From the plots, we have found that, for the most part, there was strong transmission and weak reflection over most of the vane/blade ratio range for the stator. For the rotor, there was little transmission loss.

Author

Acoustic Scattering; Aerodynamic Noise; Noise Prediction; Turbofans; Turbofan Engines; Rotor Blades (Turbomachinery); Stator Blades; Cascade Flow

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